

*Inga vera* (Willd.) Guaba

Leguminosae (Mimosoideae) Legume family

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*Inga vera* (Willd.), locally known as guaba, is one of the most widely used coffee shade species in the neotropics (5, 8, 13, 14, 16, 21, 26). It is a medium-sized tree, reaching 12 to 18 m in height and 30 to 60 cm in diameter at breast height. Guaba commonly develops a wide spreading crown of long branches and thin foliage (8, 13, 14). Basal area decreased with age in natural forests and abandoned coffee plantations in Puerto Rico (29).

**HABITAT**

**Native Range**

The native range of guaba extends from eastern Cuba, through Jamaica, Hispaniola, and Puerto Rico (fig. 1) (5, 14, 16, 20). Some discrepancy surrounds its origins in the region. Some propose<sup>1</sup> that guaba may have been introduced with cultivation (8, 15); however, because of its similarities with some species in Mexico and Honduras and its absence in the Lesser Antilles, others propose that guaba came from Central America and speciated through isolation (12, 23).

**Climate**

Guaba grows in both tropical and subtropical climates (13). It is often found in wet or moist tropical forest life zones (13) where annual precipitation ranges from 1000 to 4000 mm (7), but it has also been reported growing in dry areas (5, 13, 14). The dry season in guaba's native range is from January to March (27).

Mean annual temperatures at low elevations in guaba's native range fall in the range of 25.2 to 27.5 °C. Nowhere in the native range is the species exposed to frost.

**Soils and Topography**

Guaba grows well in a wide range of soil types, including limestone (5, 13, 16), and at elevations of up to 1,000 m above

sea level (13). It is especially common among riverbanks and in sheltered ravines (5, 13, 14, 16).

**Associated Forest Cover**

Due to the tolerance of guaba for a wide range of soil types and some drought resistance, it is often associated with a wide variety of tree species. In the subtropical wet life zone of the Luquillo mountains in Puerto Rico, guaba grows in association with species such as *Cecropia peltata* (L.), *Cordia borinquensis* Urban, *Cyathea arborea* (L.), *Croton poecilanthus* Urban, *Didymopanax morototoni* (Aubl.) Decne. & Planch., *I. fagifolia* (L.) Willd., *Micropholis chrysophylloides* Pierre, *Dacryodes excelsa* Vahl, *Prestoea montana* (R. Graham) Nichols., *Sloanea berteriana* Choisy, *Ormosia krugii* Urban, *Matayba domingensis* (DC.) Radlk., *Chionanthus domingensis* Lam., *Alchornea latifolia* Sw., *Ocotea leucoxydon* (Sw.) Mez, *Calycogonium squamulosum* Cogn., and *Eugenia stahlia* (Kiaersk.) Krug & Urban (25, 28).

**LIFE HISTORY**

**Reproduction and Early Growth**

**Flowering and Fruiting.**—Clusters (spikes) of one to four flowers are found at the bases of leaves. The spikes are made up of several stalkless flowers crowded near the end of a hairy axis. The white flowers have expanded stamens and are 5 to 7.5 cm long and 7.5 to 9 cm across (fig. 2). Only one or two flowers per cluster open daily, and flowers are fully expanded by dawn, wilting during the day. The five-part, toothed calyx is tubular, hairy, brownish green in color, and 11 to 12.7 mm long. The corolla is cylindrical, greenish yel-

<sup>1</sup> Wadsworth, F.H. 1989. [Personal communication]. Located at: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras, Puerto Rico 00928.

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Figure 1.—The native range of *guaba* (*Inga vera*).



Figure 2.—*Guaba* (*Inga vera*) leaves, flowers, and fruit (16).

low, and about 15 mm long; it has five spreading lobes, each 3 mm long, and is covered with dense brown hairs. The threadlike stamens are united into a tube inside the corolla; the pistil is white, about 6 cm long, with a narrow ovary and a very slender style. The pubescent brown seed pod is more or less cylindrical, 10 to 15 cm long, 1 to 2 cm wide, and narrow at the end; the calyx persists at the base. *Guaba* flowers and produces fruit year round (13, 14), with a peak in April and May (18). The fruit ripens and falls to the ground mainly in spring and summer (22).

**Seed Production and Dissemination.**—*Guaba* pods are large. Green weight varied from 0.40 to 0.74 g on two forest sites in Puerto Rico.<sup>2</sup> Seed dispersal is limited due to the heavy weight of the pod. Most of the pods fall to the ground and germinate near the parent trees (18), although there is some dispersal by birds and rodents (10, 12, 18, 24).

The seeds are viviparous. The radicle starts growing while the fruit is still on the tree and before the seed pod opens (12, 18). Once on the ground, the pod rots and opens, and the germination process continues rapidly (18, 20).

**Seedling Development.**—Seed germination is hypogeous and ranges from 79 to 100 percent 2 weeks after planting.<sup>2</sup> The seeds must be planted after collection to avoid fermentation of the pulp; they are short-lived and do not toler-

ate drought (20). Seedlings grow 5 to 8 cm before the first pair of leaflets appear (18) and range from 10 to 12 cm in height after they develop.<sup>2</sup>

Because the seeds start germinating before they fall from the tree, factors that would normally be adverse to seedling establishment have no influence on the germinated seeds, and this contributes to the successful establishment of *guaba* seedlings. Seedlings grow from 2.3 cm per month in shaded areas to 3.8 cm per month in gaps (18). Records of transplanted and natural forest seedlings show that the growth of *guaba* seedlings proceeds at a slow rate until there is a gap in the canopy (18).

**Vegetative Reproduction.**—*Guaba* coppices vigorously when pruned (15, 20) and is easily propagated by cuttings (2).

### Sapling and Pole Stage to Maturity

**Growth and Yield.**—*Guaba* is a relatively fast growing tree, with an annual diameter growth of up to 2.5 cm, and is able to provide shade for coffee plants in 3 years (14). Annual growth rates of *guaba* trees in lower montane wet forests in Puerto Rico are up to 1.35 cm with an average growth of 0.33 cm annually.<sup>3</sup> *Guaba* seedlings averaged 1.5 m in height at 5 months in growth and yield trials carried out in a subtropical dry forest in Costa Rica, but the trials were abandoned due to high mortality (3).

**Rooting Habit.**—Little is known about the rooting habit of *guaba*. Information compiled from coffee growers suggests that roots tend to be highly divided and shallow (12). Like other Mimosoideae, *guaba* fixes nitrogen symbiotically through *Rhizobium* bacteria (19). It produces large nodules of ectomycorrhiza. When these nodules are cut, they show a marked red color, suggesting active nitrofixation (6).

**Reaction to Competition.**—*Guaba* in natural forest habitats is a successional species (11, 29). Successional species are characteristically short-lived, fast growing, usually good seed dispersers, and shade intolerant.

**Damaging Agents.**—Old *guaba* trees are highly susceptible to attacks by *Myrmelachista ramulorum* Wheeler (15, 17, 30), an ant that tunnels through branches, twigs, and trunks of trees. The damage is aggravated because the ant protects honeydew-producing insects that feed on the tree (16). Other insect pests of *Inga* spp. include the leaf-webber, *Tetralopha scabridella* Ragonot, which causes severe defoliation, and *Xyleborus affinis* Eichhoff, a very common beetle that attacks both healthy and unhealthy trees (17). *Platypus ratzenburgi* Chapuis, a wood-boring beetle, has also been reported to cause severe damage to *guaba* trees (9).

A root disease, which is probably caused by a fungus or a bacterium, produces a loss of sap from the stem, necrosis, and the eventual death of the tree (4, 15).

<sup>2</sup> Francis, John. 1989. [Personal communication]. Located at: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras, Puerto Rico 00928.

<sup>3</sup> U.S. Forest Service. Unpublished data on growth in Tabonuco and Palm Forest. Located at: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Rio Piedras, Puerto Rico 00928.

## SPECIAL USES

The primary use of guaba is as shade for coffee plantations (2, 5, 8, 12, 14, 15, 17, 20, 21). Its wood is moderately heavy, with a specific gravity that ranges from 0.57 to 0.75 g/cm<sup>3</sup> (2, 8, 12, 14, 20). The sapwood is whitish and the heartwood pale brown (8, 12). It makes excellent fuelwood (2, 5, 12, 14, 20, 21) and is also used for charcoal (12) and posts (2, 12).

The wood is also used for furniture, boxes, crates, light construction, and general carpentry (12, 20). However, the wood decays easily in the ground and is susceptible to dry-wood termites (12, 20). The seed pulp is sugary and edible (5, 12, 14, 20, 21), and the flowers are known to attract bees (2, 13, 14, 20).

## GENETICS

The genus *Inga* contains 150 to 300 species, ranging from shrubs (3 to 4 m tall) to medium-sized evergreen trees (25 m in height) (1). *Inga vera* is often confused with the very similar *I. eriocarpa* and *I. spuria*. Although guaba has been classified as merely a subspecies (12), it is most commonly accepted as a distinct species.<sup>4</sup>

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